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RESEARCH ARTICLE

Implications and Learnings of Measles Outbreak Through a Clinician's Lens; Mumbai, India 2022–2023

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ABSTRACT

Background: **The COVID-19 pandemic has disrupted preventive healthcare, including routine vaccination coverage and surveillance systems. According to the WHO, approximately 40 million children missed measles-containing vaccine (MCV) doses between 2020 and 2021, posing a global threat of measles outbreaks.**

Objective**: This study aimed to investigate the clinical and demographic profiles of suspected Measles children visiting tertiary care hospitals during the measles outbreak in Mumbai, India, during 2022–2023.**

Methods**: A prospective, descriptive study was conducted at a tertiary care hospital in Mumbai from October 2022 to March 2023. The study included 100 consecutive patients aged 1 month to 14 years admitted to the pediatric ward with fever and maculopapular rash. Data collection involved clinical and demographic information, with analysis using Microsoft Excel 2010 and SPSS V23. Chi-square tests and Fisher's Exact test were applied to evaluate associations between various factors and outcomes.**

Results**: Among the 100 patients, 32 (32%) were under 9 months, 43 (43%) were between 9.1 to 60 months, and 25 (25%) were over 60 months. Male preponderance was seen with a total of 57 (57%) male patients. The study found 62 (62%) of patients were unvaccinated. Clinical presentations included prodromal symptoms 89 (89%), breathing difficulties 34 (34%), GI symptoms 30 (30%), and complications like pneumonia (32%), acute gastroenteritis (17%), and otitis media (8%). Out of 100 patients, 96 were cured and discharged while 4 patients died. All 4 fatalities were among unvaccinated patients, emphasizing the importance of vaccination.**

Conclusion**: The study highlights mortality and morbidity following the resurgence of measles due to decreased vaccination rates during the pandemic. It underscores the need for improved routine and supplementary immunization activities to achieve measles elimination targets. Additionally, the study raises the question of whether the age for the first measles dose should be reduced to 6 months due to the observed waning immunity from maternally transferred antibodies. The real threat of this outbreak will be the long-term sequalae- Subacute Sclerosing Pan Encephalitis (SSPE) which is anticipated to rise in the coming years.**

Keywords: Age at vaccination, complications, Measles outbreak, SSPE.

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1. Introduction

The COVID-19 pandemic has set us back in the field of preventive health care due to stringent lockdowns, isolations and quarantines which led to constant reduction in routine vaccination coverage. According to WHO, a high record of about 40 million children missed MCV (measles containing vaccine) dose in 2020–2021 [1]. This led to an imminent threat of measles spreading globally.

Measles being a highly contagious viral illness caused by a Paramyxovirus (morbillivirus genus) is preventable through vaccination and has a high secondary attack rate (over 90%) among susceptible household contacts [2].

Symptoms include fever, cough, coryza, conjunctivitis, and a characteristic maculopapular rash that appears 3 to 5 days after initial symptoms [3], [4]. Complications, like otitis media, pneumonia, and encephalitis, can be fatal, especially in young children, malnourished individuals, or those with weakened immune systems [5]. Target immunisation coverage by measles-containing vaccine (MCV) should be 95% to prevent community outbreaks.

This is a study to determine the clinical, and demographic profile of patients, specifically children aged less than 9 months with measles during the outbreak in 2022–23 in Mumbai, India.

1.1. Aim

To study the implications and learnings of the recent Measles outbreak in 2022–2023.

1.2. Objectives

The objectives are the following:

- Study of clinical and demographic profile of children with measles
- Comparison of morbidity and mortality between patients of measles who were vaccinated and patients who were unvaccinated
- Study of the post-measles complications

2. Materials and Methods

A prospective, descriptive study was conducted at a tertiary care hospital in Mumbai, India from October 2022 to March 2023. The study focused on a study population that included all consecutive patients admitted to the paediatric ward, aged 1 month to 14 years, and presenting with symptoms of fever and maculopapular rash. The sample size for this study was 100 patients, selected using convenience sampling methods.

Inclusion Criteria was any patient with a history of fever and rash between 1 month and 14 years of age, fulfilling the following case definition.

Case definition of a suspected measles case—As per the Measles and Rubella Surveillance Field Guide 2020 (Issued by MOHFW, GOI) [6]—Any person with fever and maculopapular (non-vesicular) rash and any one of the 3 C's: cough, coryza, conjunctivitis or Any person in whom a health worker or a clinician suspects measles infection.

District Immunization Officer, Surveillance Medical Officer, and District Surveillance Officer flag outbreaks if there are five or more suspected measles cases or a suspected measles death in one area or contiguous areas of adjacent blocks in the four weeks duration.

Exclusion criteria was patient not fulfilling case definition of suspected measles, patients not willing for admission and parents/guardians who do not consent for study.

Institutional Ethics Committee approval was taken. The data collection procedure for this study involved the entry of all relevant clinical and demographic information into a structured proforma, with subsequent analysis of the results. Serum IgM and throat swab reports were obtained to supplement the clinical data. Data was meticulously collected and recorded in an Excel spreadsheet, after which it was analysed using appropriate methods.

2.1. Statistical Analysis

The data was compiled with the help of Microsoft excel 2010 and a descriptive analysis was done with the help of SPSS V 23 IBM corporation.

Numerical data of hemodynamic parameters like age in years, duration of hospital stay etc., was expressed as means and standard deviation (SD) (Gaussian distribution).

Categorical data like, age group, gender, comorbidities, clinical features, Vaccinations status, Serum IgM, outcome etc., was described using numbers and percentages.

The association between outcome, prolonged hospital stays and age group, gender, Vaccination Status, comorbidities, Serum IgM etc., was analysed Using chi-square test/Fisher exact test for categorical variables as appropriate. A two-sided p-value of <0.05 will be considered significant.

3. Results

A total of 100 patients were studied. We categorised patients into 3 categories–less than 9 months, 9.1 to 60 months and more than 60.1 months. In the first subset (n1 = 32), 18 (56%) were male, in the second subset (n2 = 43), 26 (60.5%) were male and in the third subset (n = 25), 13 (52%) were male.

Vaccination status was also recorded for all these 3 categories as shown in Table I. All infants below 9 months were unvaccinated. A total of 62 (62%) patients in the study were unimmunised. The mean age of the vaccinated group was 43.76 months and the unvaccinated was 28.09 months (Table II) (p-value 4.29e−05).

The various clinical features with which these children presented were also analysed. Prodromal symptoms were present in 89 (89%), breathing difficulties in 34 (34%), GI symptoms like diarrhoea, vomiting abdominal pain in 30 (30%), while CNS symptoms like seizures and altered sensorium in 5 (5%) and 3 (3%), respectively. The classical presentation of fever with 3–5th day rash was seen in 66 (66%) children while an indistinct or brief rash indicative of Modified Attenuated Measles was seen in 28 (28%).

Although, most 79 (79%), did not have any pre-existing comorbidities, about 12 (12%) had Severe Acute Malnutrition. Other comorbidities like Thalassemia, Tuberculosis, Congenital heart diseases and congenital anomalies showed a prevalence of 2% each while Post covid Multisystem inflammatory syndrome in children, pancytopenia and TB with HIV showed a prevalence of 1% each.

The diagnostic findings related to serum IgM levels showed that 69 (69%) patients were from positive outbreak areas, while 25 (25%) were positive and 6 (6%) were negative. Abnormal chest X-rays were seen in 13 (40.6%) patients out of a total of 32 patients in the less than 9 months category. Fig 1 shows the Chest X-ray findings with respect to vaccination status where 7 (23.3%) of unvaccinated and 14 (45.2%) vaccinated children had abnormal CXRs.

TABLE I: Vaccination Status

Vaccination status	Unimmunised (n1 = 62)	Partially immunised (n2 = 15)	Completely immunised (n3 = 23)	Total (n = 100)
<9 months	32	–	–	32
9.1 months–60 months	17	13	13	43
>60.1 months	13	2	10	25
Total n = 100 (%)	62 (62%)	15 (15%)	23 (23%)	100

TABLE II: Comparison of Age Among the Cases by Vaccination Status

Variables	Vaccination status	Mean	SD	Median	IQR	Z-value	p-value
Age (months)	Vaccinated	43.76	33.59	36.00	37.50	−4.091	4.29E−05
	Unvaccinated	28.09	37.00	9.00	33.00	**Difference is significant**	

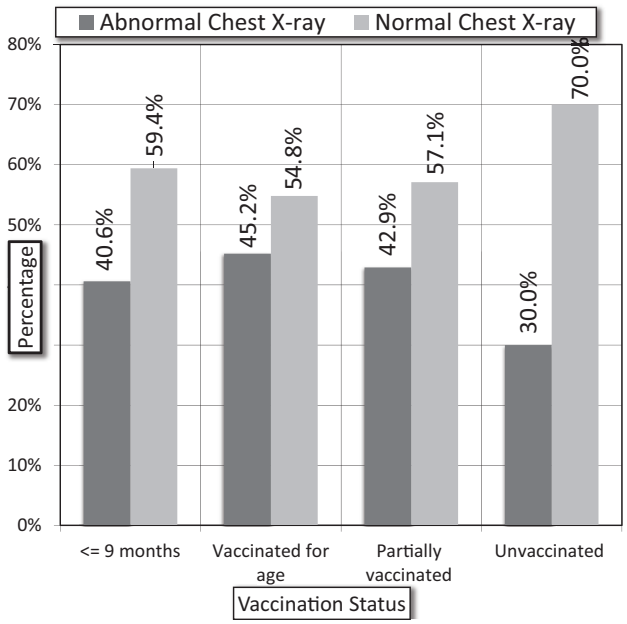

Fig. 1. Chest X-ray findings by vaccination status number (% age).

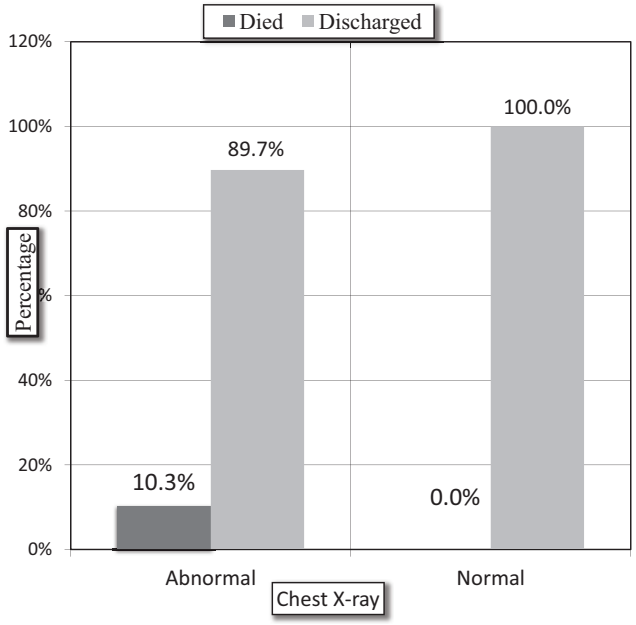

Fig. 2. Chest X-ray findings versus outcome of illness.

Data regarding Measles complications showed that most unimmunised patients had pneumonia 32 (32%), 17 (17%) had Acute gastroenteritis and 8 (8%) had otitis media. Table III gives a relation of the different complications observed with the status of immunisation. It was also observed that in less than 9 months old patients, complications were seen in 17 (53.1%) of them out of a total 32. Whereas seen in 24 (55.8%) and 9 (36%), respectively in the 9.1–60 months and >60 months age group. Post measles complications were seen in 22 (53.7%) females out of 41, and 28 (47.5%) males out of a total of 59.

Out of a total of 100 patients, 96 were cured and discharged and 4 had died. Two patients (4.7%) died out of 43 in the 9.1–60 months age group. One (3.1%) died out of 32 in the less than 9 months group and 1 (4%) in the >60 months age group out of 25. It is noteworthy that these 4 patients were unvaccinated and had abnormal chest X-rays (p-value = 0.01) (Table IV, Fig. 2).

Amongst the discharged patients, it was noticed that 40 (40%) had a prolonged hospital stay. Out of these 3 (7.5%) of them died. One (1.7%) patient died out of the rest 60 patients in less than 10 days of ward stay. Three out of a total of 21 patients with comorbidity died, while one without any comorbidly in the less than 9 months age category also succumbed (p-value = 0.07) (Table V, Fig. 3).

Prolonged hospital stay was also seen with respect to vaccination status in 12 (38.7%), 5 (71.4%) and 10 (33.3 %)

TABLE III: Measles Complications Seen in the Study

Complications	Number	Unimmunised (n1 = 62)	Received 1 dose (n2 = 15)	Immunised (n3 = 23)
Pneumonia	32 (32%)	18	8	6
AGE	17 (17 %)	8	4	5
Otitis media	08 (8%)	6	1	1
Flare of TB	1	1	0	0
Encephalitis	0	0	0	0
None	37	18	7	12

TABLE IV: Association Among the Cases Between Outcome and Chest X-ray

Chest X-ray		Outcome		Total
		Died	Discharged	
Abnormal		4 (10.3%)	35 (89.7%)	39 (100%)
Normal		0 (0.0%)	61 (100%)	61 (100%)
Total		4 (4.0%)	96 (96%)	100 (100%)
Chi-Square tests	**Value**	**df**	**p-value**	**Association is-**
Pearson Chi-Square $	6.517	1	0.011	Significant
Continuity correction $	4.120	1	0.042	Significant
Fisher's exact test			0.021	Significant

TABLE V: Association Among the Cases Between Outcome and Comorbidity

Comorbidity		Outcome		Total
		Died	Discharged	
Yes	n (%)	3 (14.3%)	18 (85.7%)	21 (100%)
No	n (%)	1 (1.3%)	78 (98.7%)	79 (100%)
Total	n (%)	4 (4%)	96 (96%)	100 (100%)
Chi-Square Tests	**Value**	**Df**	**p-value**	**Association is-**
Pearson Chi-Square $	7.324	1	0.007	Significant
Continuity correction $	4.326	1	0.038	Significant
Fisher's exact test			0.028	Significant

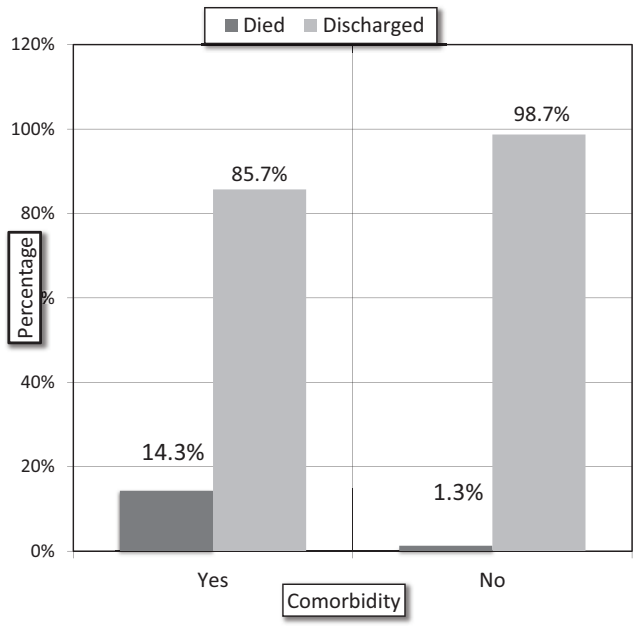

Fig. 3. Outcome of illness versus comorbidity.

patients of vaccinated for age, partially vaccinated and unvaccinated groups, respectively.

4. Discussion

This study revealed that maximum children were (n = 43) between the age category of 9.1 to 60 months. In all the 3 age groups, male predominance was seen. This finding is in line with the study done by Mishra *et al*. [7] which also showed the same gender predominance. They also had a bimodal distribution of cases with a peak incidence in 2–3 years age and in 5–9 years age group.

In a study done by Ray *et al*. in Kolkata [8] it was found that amongst the measles cases only 19.7% were immunized with measles vaccine. Mishra *et al*. study [7] also states that 18% of measles cases had received a measles vaccine.

Our study showed that out of all the measles cases, 62 (62%) were unvaccinated. This was mainly attributed to the study period as it involved the post COVID -19 pandemic years.

WHO data showed that up to November 2022, almost 40 million children worldwide had missed a measles vaccine dose in the last year [9]. In our study group, the most common presentation was that of classical measles which was similar with the Ray *et al*. [8] study. We found that the most common associated condition with measles was severe acute malnutrition (SAM), which according to WHO guidelines should be treated as complicated measles with an inpatient admission [10].

Measles virus can cause lower respiratory tract infection hence chest X-ray is essential for investigation. In an Italian study by Albarello *et al*. it was shown that 88.5% of the measles cases had abnormal CXR findings [11]. In our study, 34 (34%) patients had abnormal CXR findings.

In a Romanian study by Turaiche *et al*. it was shown that among the post measles complications, children suffered significantly with Pneumonia 63 (60.6%) and otitis media 12 (11.5%) which was more as compared to our reported findings [12].

A noteworthy finding in our study was that all 4 patients who died were unvaccinated. In the study done by Indwar *et al*., it was shown that 13 patients out of a total of 584 had succumbed, which is a lesser mortality incidence than our study [13].

5. Limitations

The study was conducted in tertiary hospital hence sample may not be representative of community setting. But those who seek healthcare are presumed to have more awareness or more serious disease which seem to balance the effect of setting of study.

6. Conclusion

This study included 100 consecutive admitted cases of measles at our hospital. Due to the COVID-19 pandemic, a downward vaccination trend was observed which resulted in the resurgence of Vaccine-preventable diseases. Furthermore, considerable number of cases were below 9 months of age, indicating waning immunity of maternally transferred antibodies. It now brings up a vital question, whether the age of the first measles dose should be reduced to 6 months?

This measles outbreak started in the month of September 2022 in Mumbai and continued till March 2023. In 2022, Maharashtra state recorded the highest number of cases as 3075 and 13 deaths [14]. The real threat of this outbreak will be the long-term sequalae- Subacute Sclerosing Pan Encephalitis (SSPE) which is anticipated to rise in the coming years. It will pose a significant burden on healthcare as well as society as the mortality rate of SSPE is high.

Hence vaccination has become imperative to curtail these diseases. Increased routine immunisation and supplementary immunisation activity are required to achieve the target of measles elimination. Also, policymakers should make evidence-based decisions on the right timing of vaccine.

Authors Contribution

The study was conceptualised by Dr Bela Verma. Data collection and analysis was done by Dr Vinita Tripathy. The review of Literature was done by Dr Suhani Jain. Manuscript drafting was done under the guidance of Dr Bela Verma and manuscript review and editing was done by Dr Bela Verma and Dr Meeta Vashi.

Conflict of Interest

Authors declare that they do not have any conflict of interest.

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